Improvement of survey and sampling methods to document freedom from diseases in Danish cattle population on both national and herd level

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Introductory Seminar

Improvement of survey and sampling methods to document freedom from diseases in Danish cattle population on both national and herd levels

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Disease Freedom in DK

- **Theme 1 --- International EpiLab**
- **Aim is to initiate and validate a guideline for declaring a country free from a disease using existing survey and surveillance sources**

Why important?

- Increased trade (exports and imports) animals and animal products
- More countries (regions) interested in new trade opportunities – *need for policy decisions based on scientifically-sound risk analyses*

Disease Freedom in DK

- Three projects are closely related
- Cooperatively develop consistent approach for establishing disease freedom
- Each project concentrates on developing specific approaches/strategies of the overall methods
- Apply the approaches in three livestock systems (Poultry, Swine, and Cattle)

Definition

"Disease freedom" **– commonly-used term but we really mean**

"Absence of the Pathogen (free from pathogen)"

Definition

"Free from a pathogen" – note that in some countries it actually means a herd prevalence < threshold value

- e.g. IBR free areas in the EU – threshold is <0.2% (2 in 1000) positive herds

Freedom – all species?

"Free from a pathogen" – **strictest sense means absence of the pathogens from animals, the environment, and potential wildlife reservoirs**

Demonstration of disease freedom

"Proof" theoretically requires

- Perfectly sensitive test
- Testing of all animals in a country, region, state, zone etc

- *"Absolute proof" is unrealistic*

Evidence of disease freedom

- Evidence provided to trading partners who make judgements
- Importing countries make judgements about trade (animals and animal products)
  - no trade
  - trade with mitigations
  - unrestricted trade

Evidence of disease freedom

Based on considerations such as:

- Surveillance system – neg. results
- Population survey that yields neg. results
- Other factors – Awareness of producers, preparedness of practitioners, quality of vet services, lab system, historic performance in detection of disease, other disease risks

Two scenarios….

1. Country has historically been “free” of pathogen

   e.g Australia and PRRS in pigs – geographical isolation, strict quarantine

2. Pathogen is being eradicated (or has been eradicated)

   e.g. CBPP in U.S.

Other diseases !!! …..

- **For many diseases, need statistically valid population-based survey with internationally-recognized test to increase confidence in the negative surveillance results**
- **Tests – usually serologic (Se and Sp < 100)**
- **Expect to find 0 reactors in the survey**

Survey caveats……

- **No survey is able to "guarantee" that a population is free of a pathogen**
- **Possible that a very small number of (or even a single) infected animal exists in a population and was not selected in a sample**

Survey result as a test

		Absence - DZ "Freedom"	Presence-DZ "Not-Free"
Survey Result	No DZ	Correct	Type I error
	Yes DZ	Type II error	Correct

Pr (No DZ/Freedom) = Pr (S-/F)

Pr (Yes DZ/ Not-Free) = Pr (S+/NF)

Interpreting a negative survey result

Pr (S- | F) depends

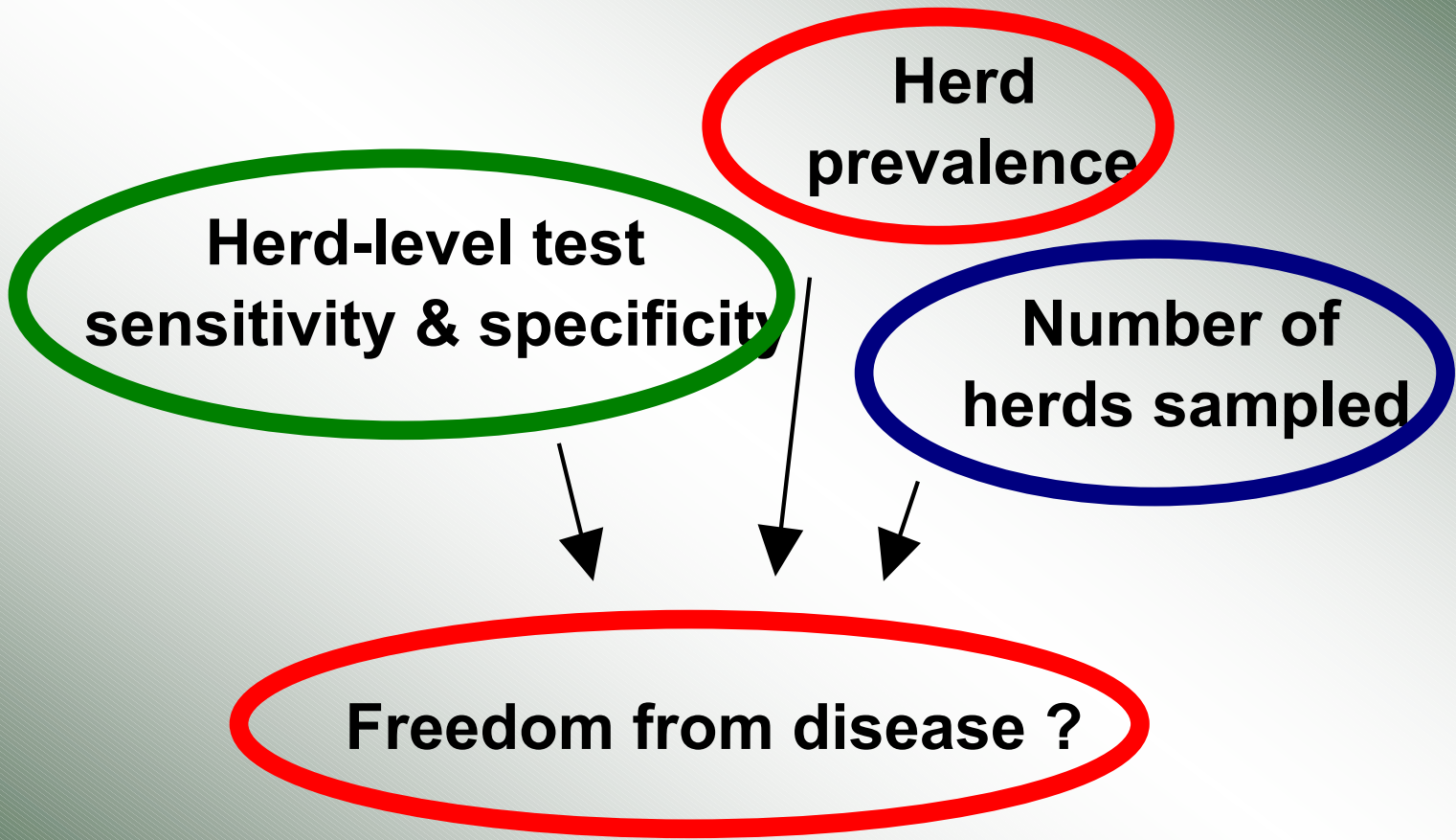
- **Pr (Freedom) before survey**
- **Threshold used for classification**
- **Sensitivity and Specificity of the used diagnostic system**

Interpreting a negative survey result

Pr (F| S-) depends

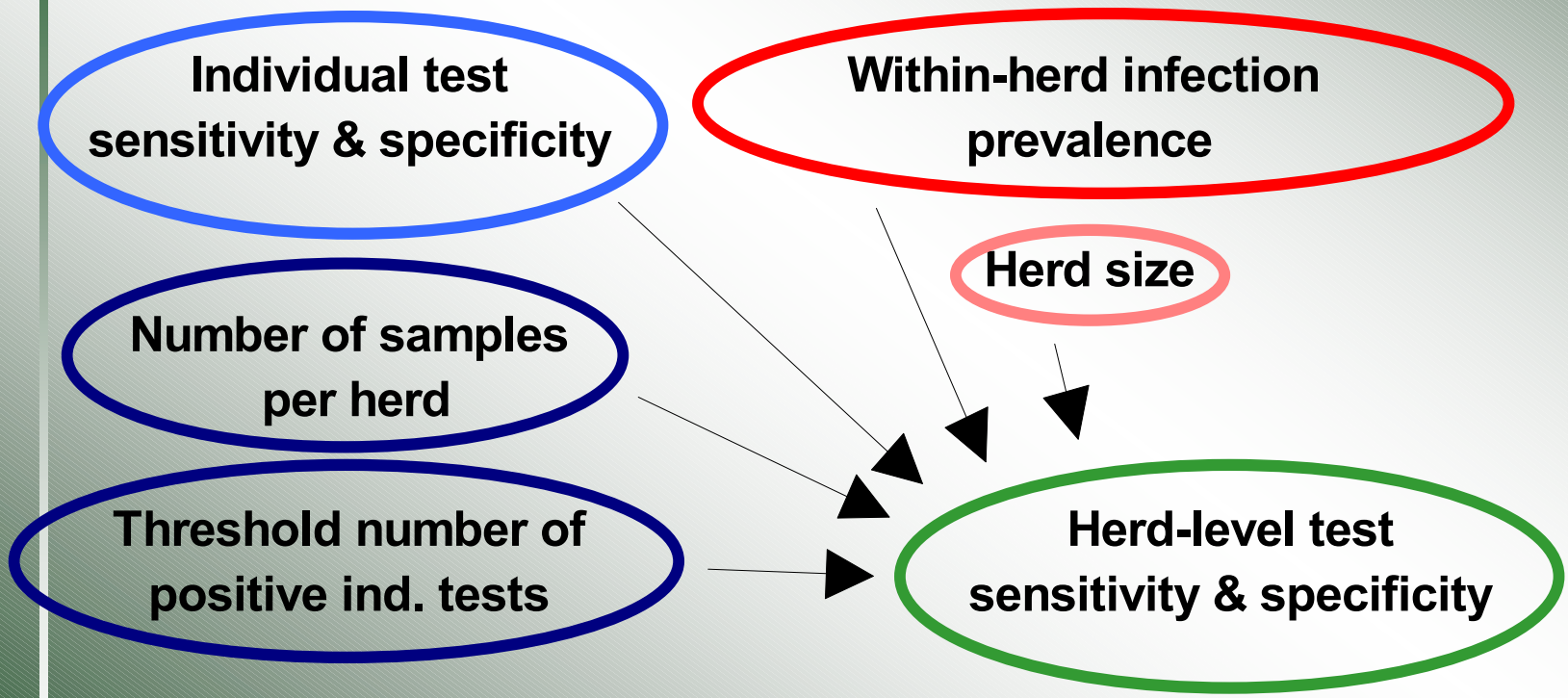
- **Pr (Freedom) before survey**
- Pr (S-/F) **and** Pr (S+/NF) **of survey**
- **Specificity of the diagnostic system for the survey**

Survey-level diagnostic system



Number of Expected test-positive herds

Herd-level test sensitivity and specificity



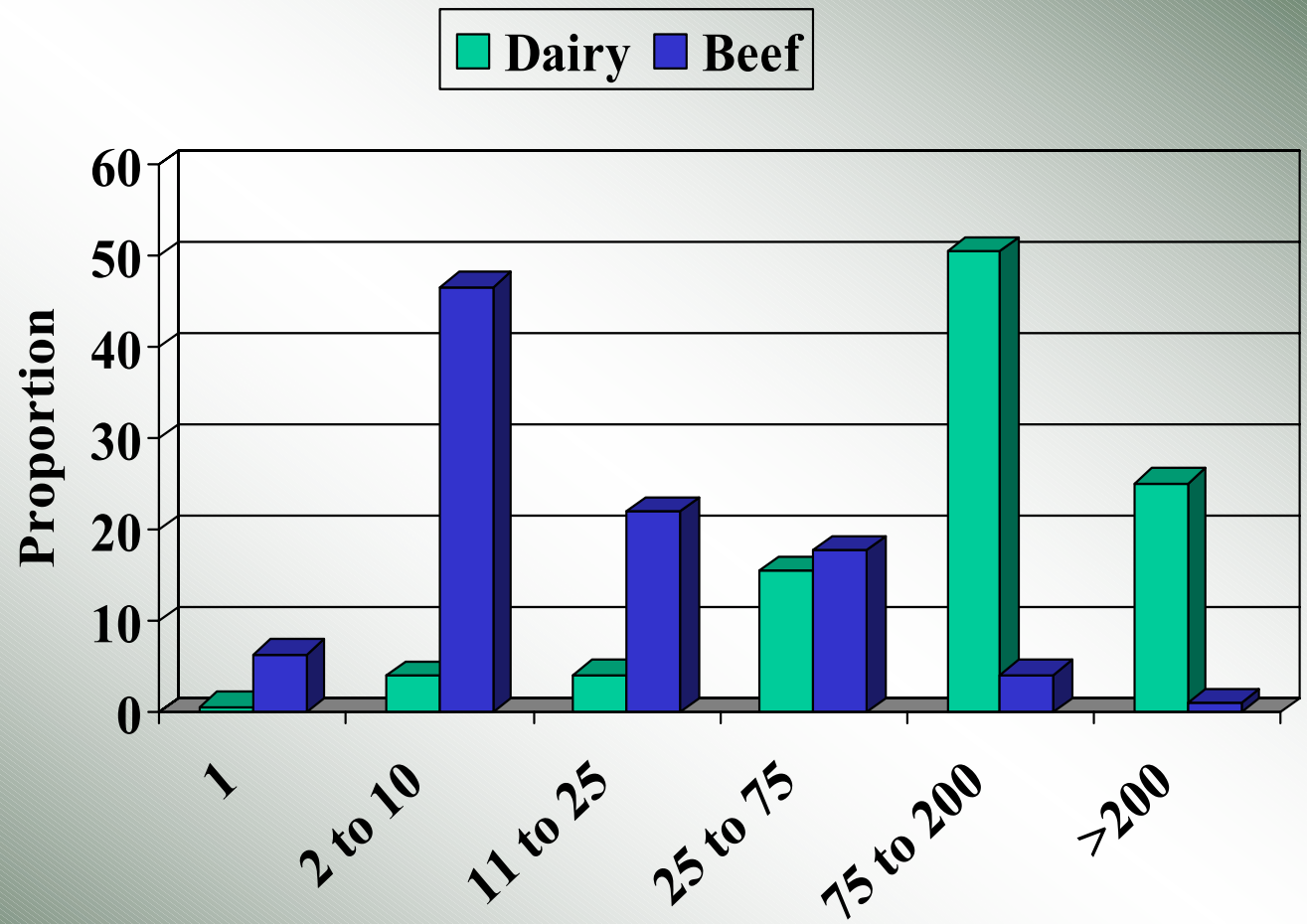
The current DK surveillance system (IBR as a disease model)

- **Description of the population dynamic including cattle movement, production type,**
- **Description of the sampling strategies: slaughter surveillance vs. bulk tank milk surveillance**
- **The impact of the current sampling strategies if an IBR case herd exists**
- **Simulation models to assess the effectiveness of the current sampling strategies**

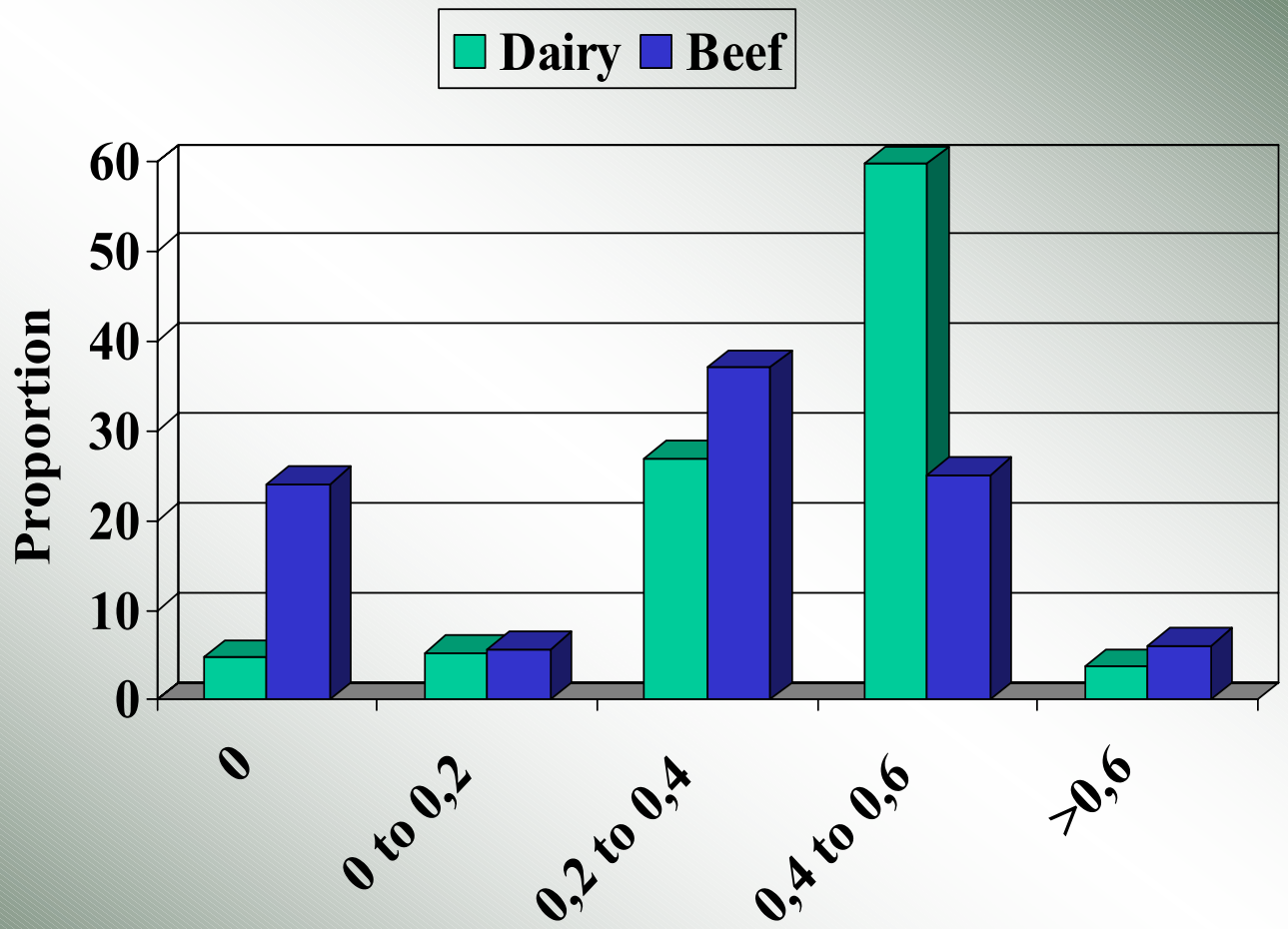
General statistics (Kvægdatabasen)

- Year 1998 through 2001
  - ~9000 dairy herds; 23000 beef herds
- Spatial distribution
- Slaughter house information (export, domestic)
- Movement
- Slaughter Surveillance data 2000-2001
- Milk tank Surveillance data 1998-2001

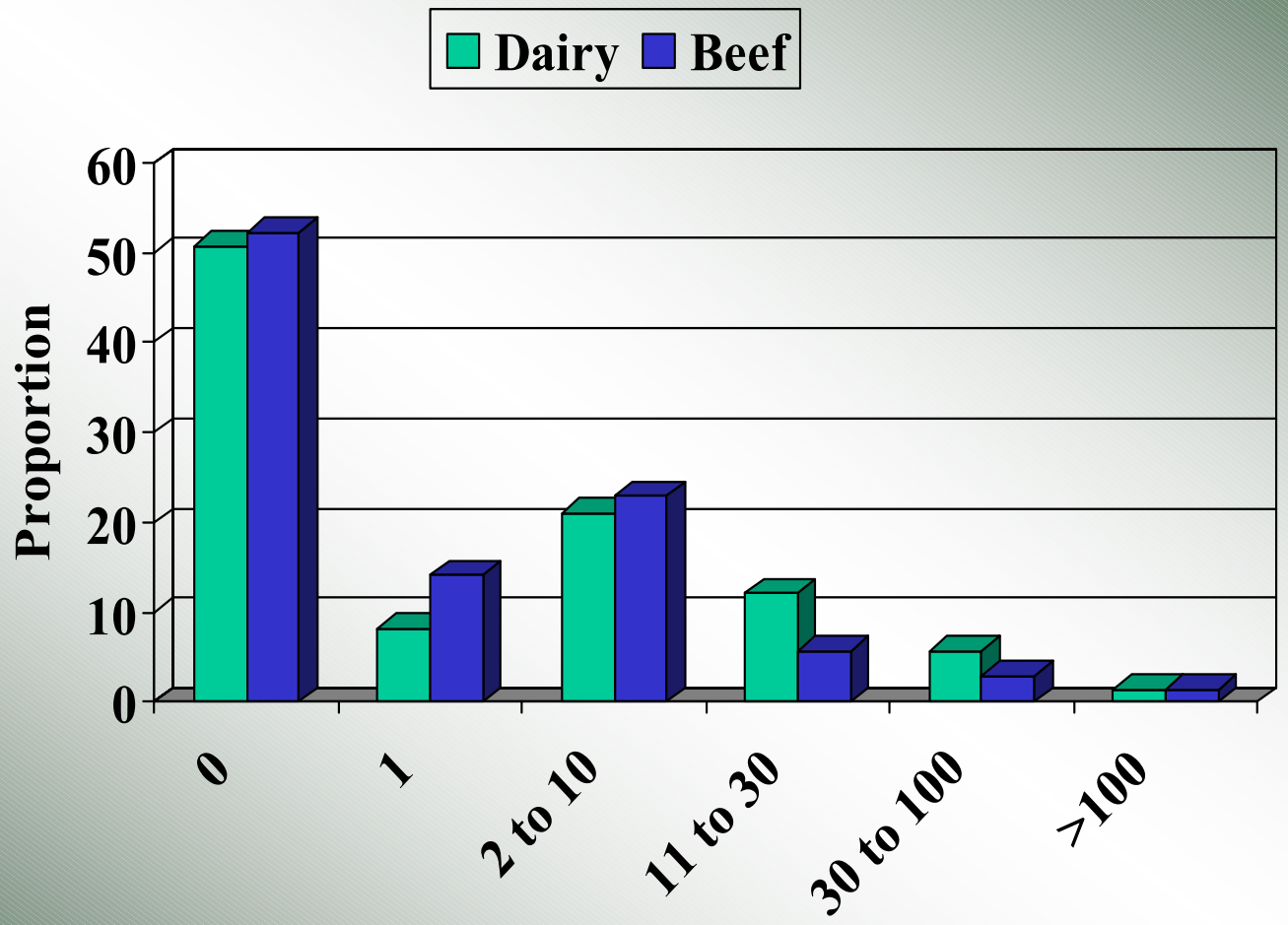
Herd size of DK cattle in 2002



Proportion adult cows 2002



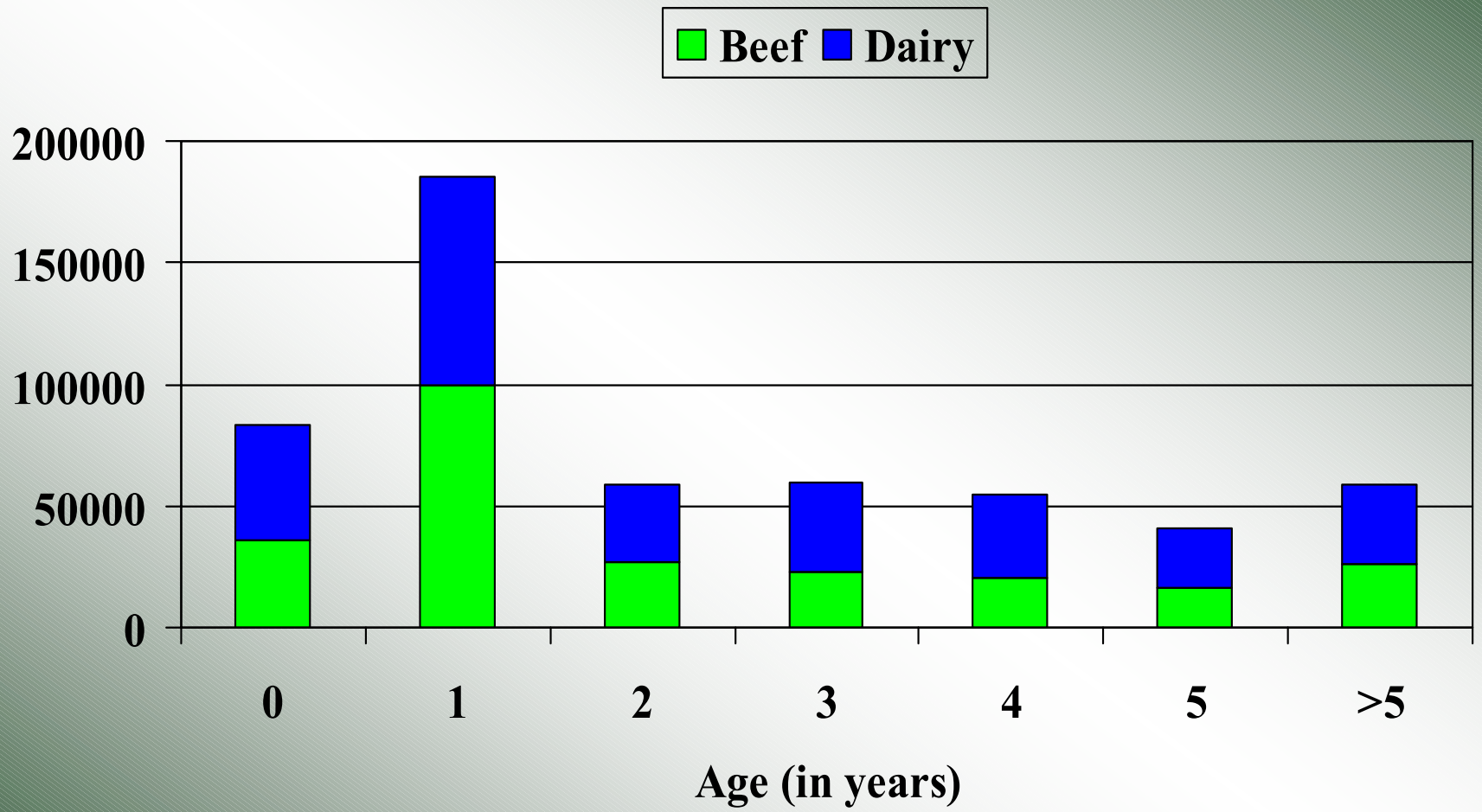
Proportion of herds received cattle in 2001



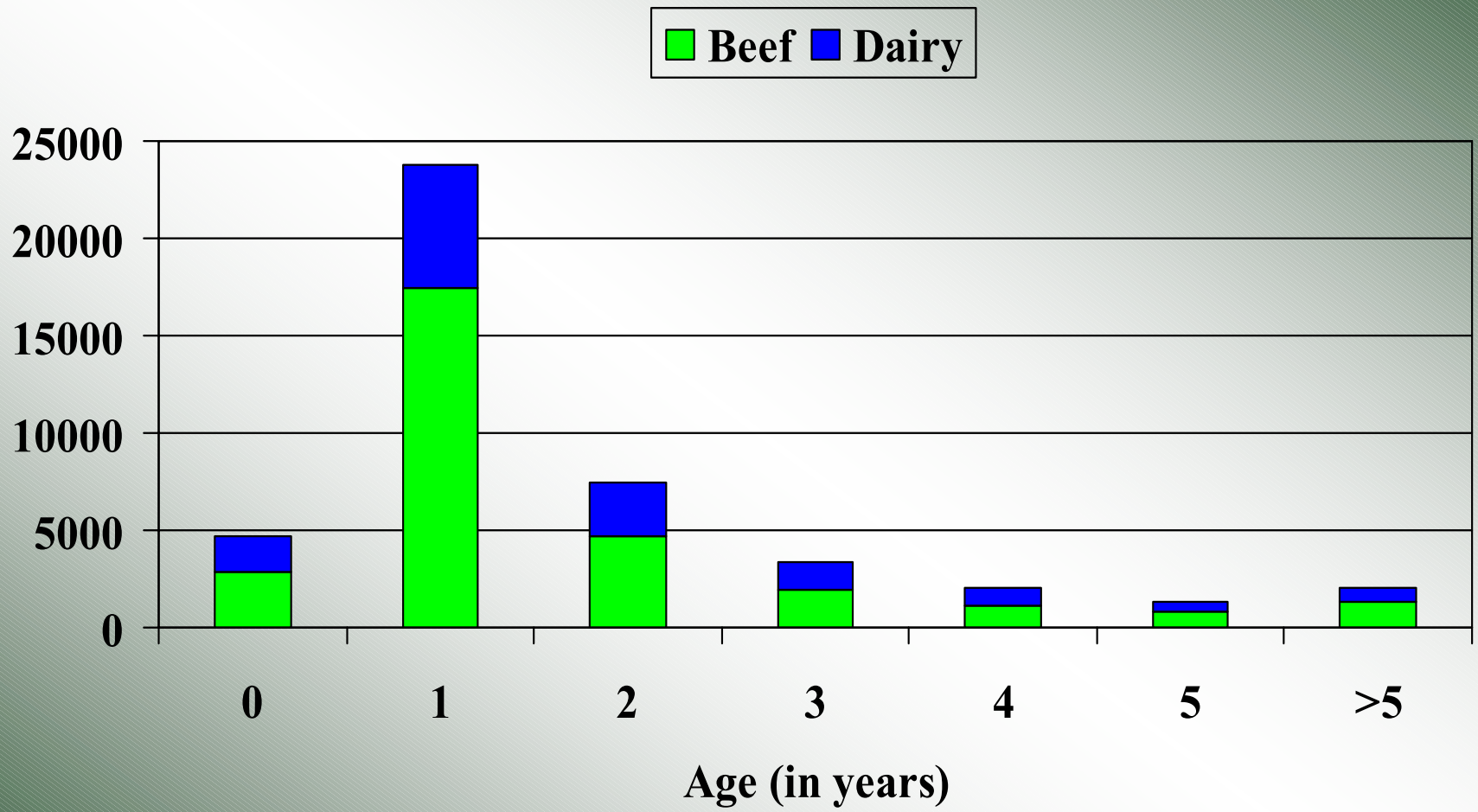
Median herd size 2001 for slaughtered cattle

- **At export:**
  - **Dairy 159**
  - **Beef 7**
- **at domestic**
  - **Dairy 137**
  - **Beef 14**

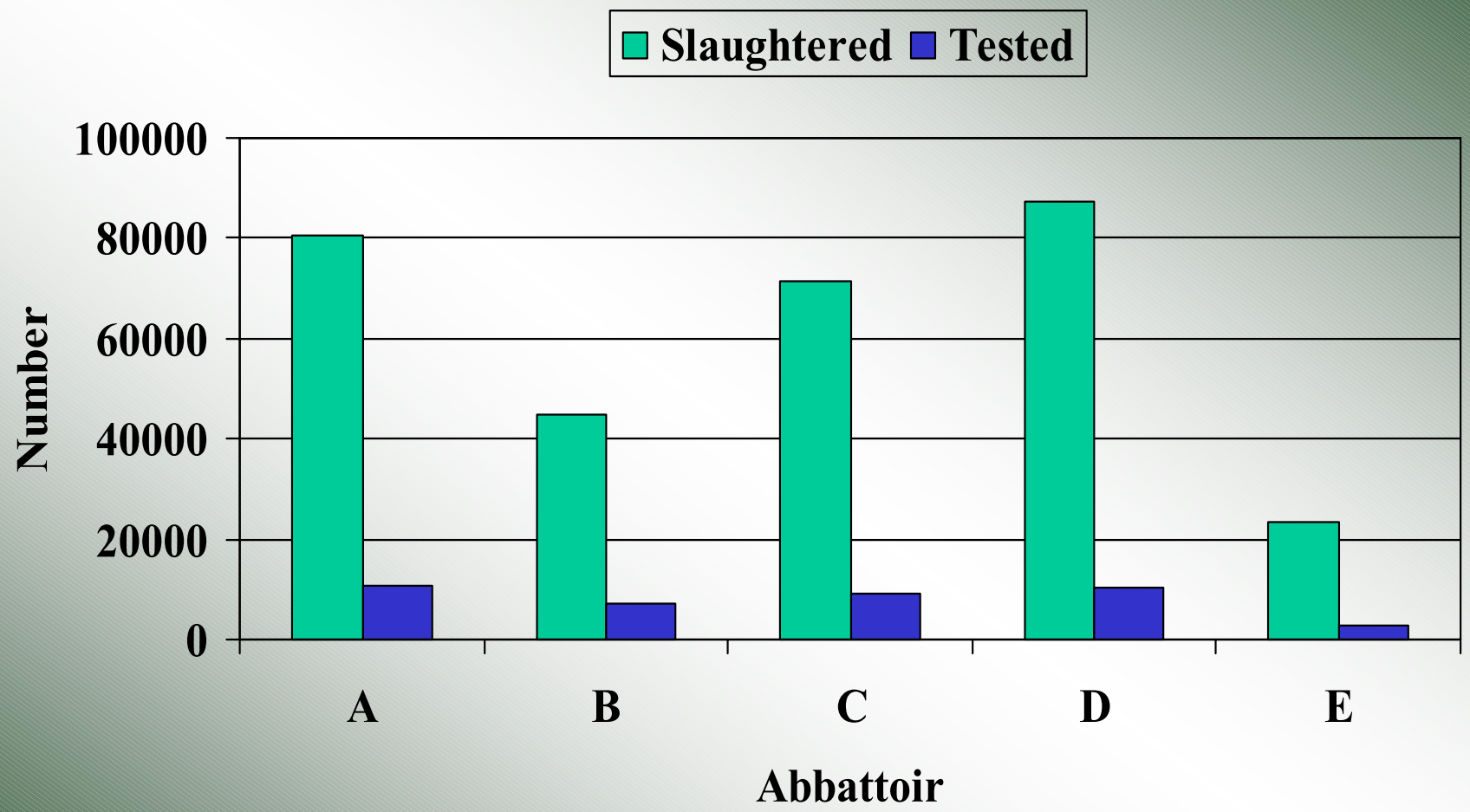
Age of slaughtered cattle (export)



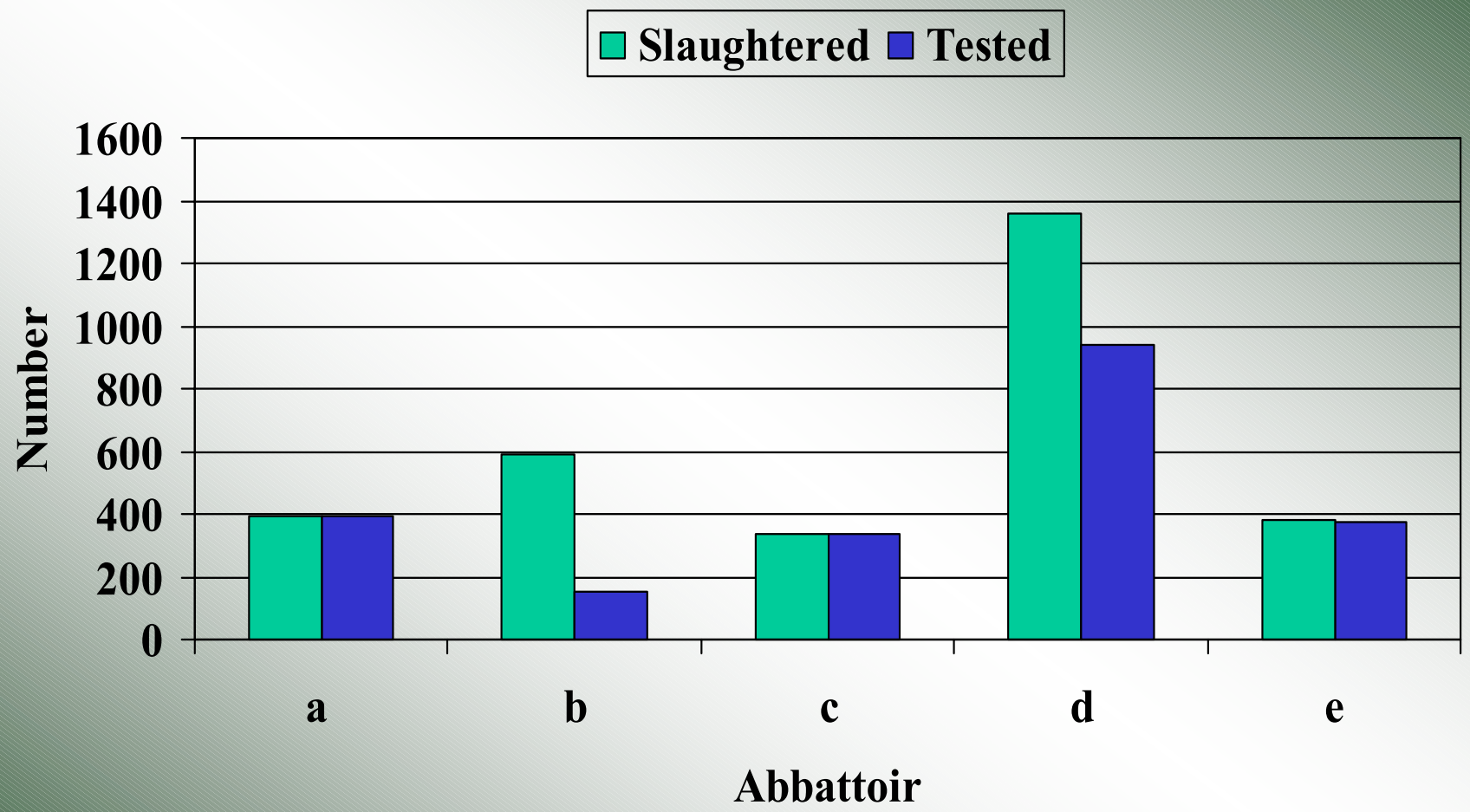
Age of slaughtered cattle (domestic)



IBR tested 2001(export)

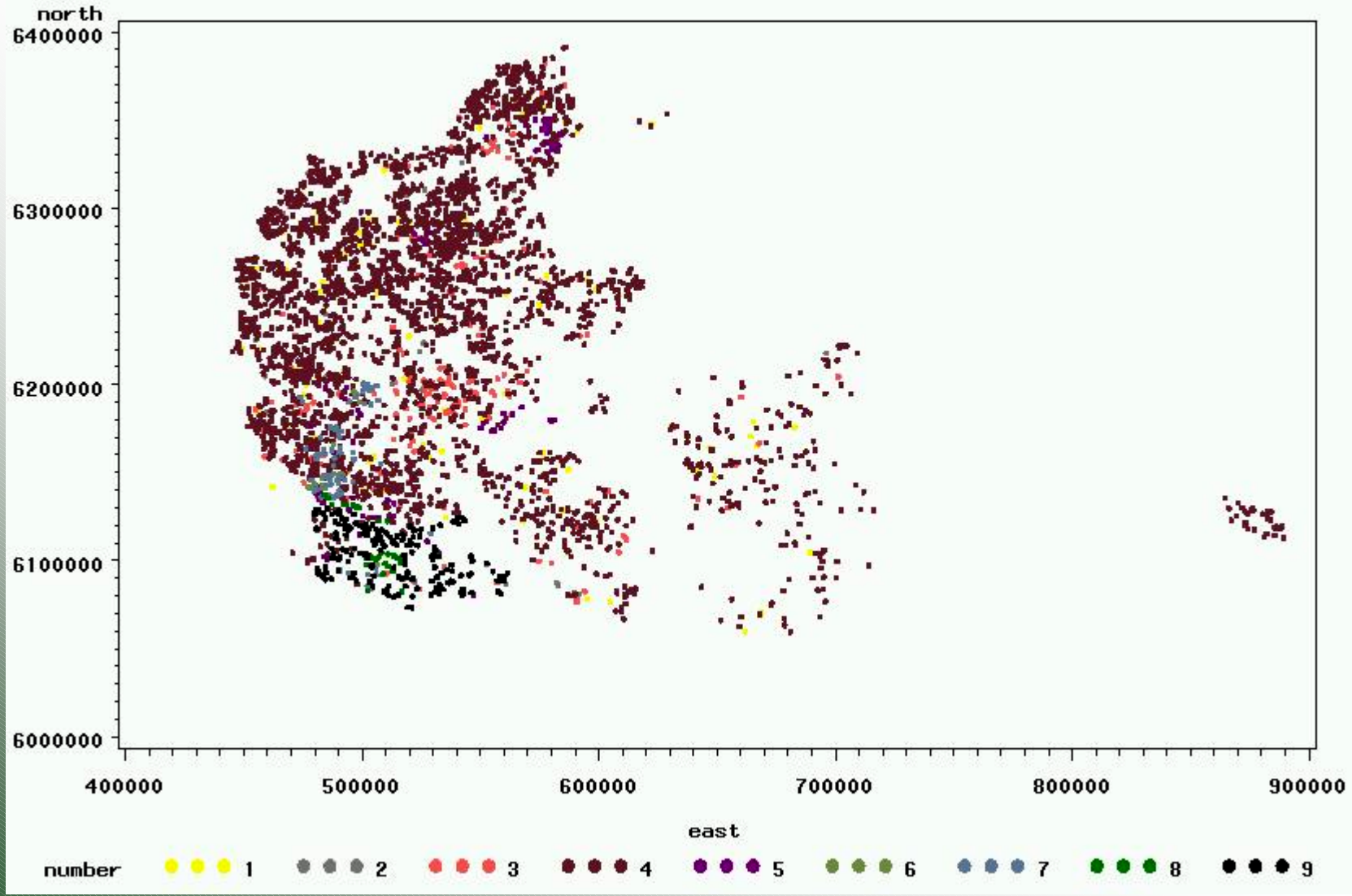


IBR tested 2001(domestic)

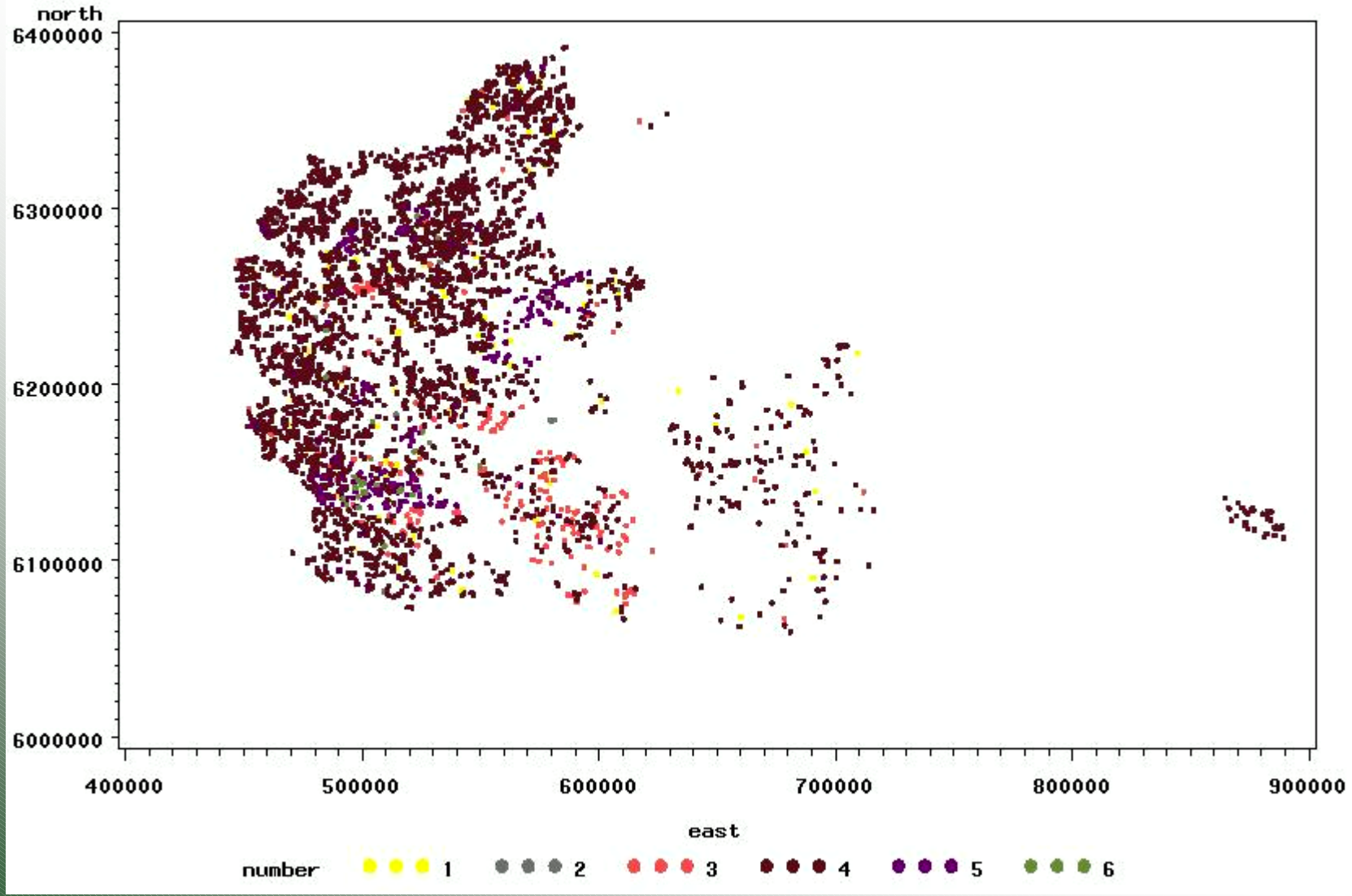


INTERNATIONAL EpiLab

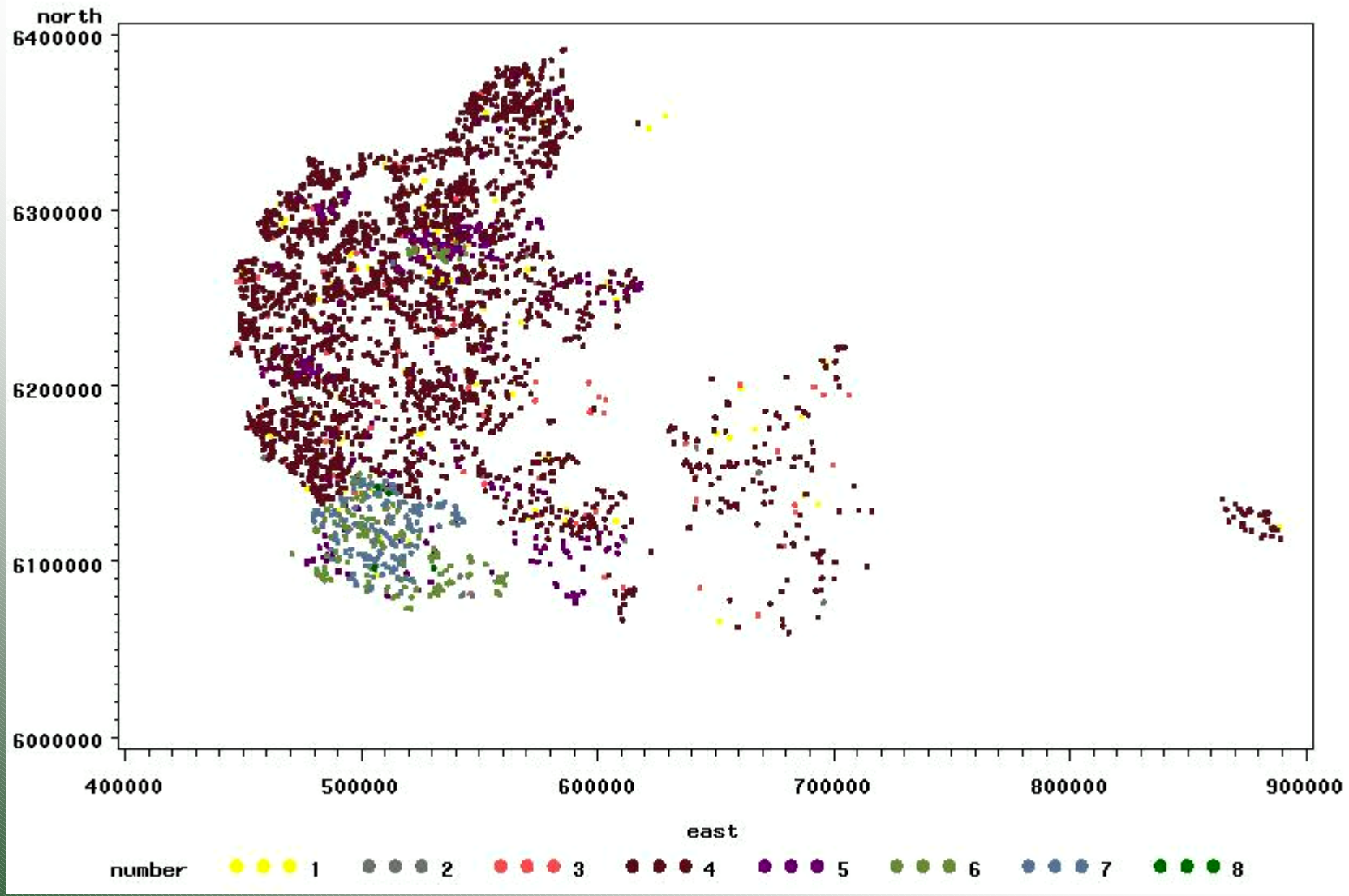
1998 milksampling



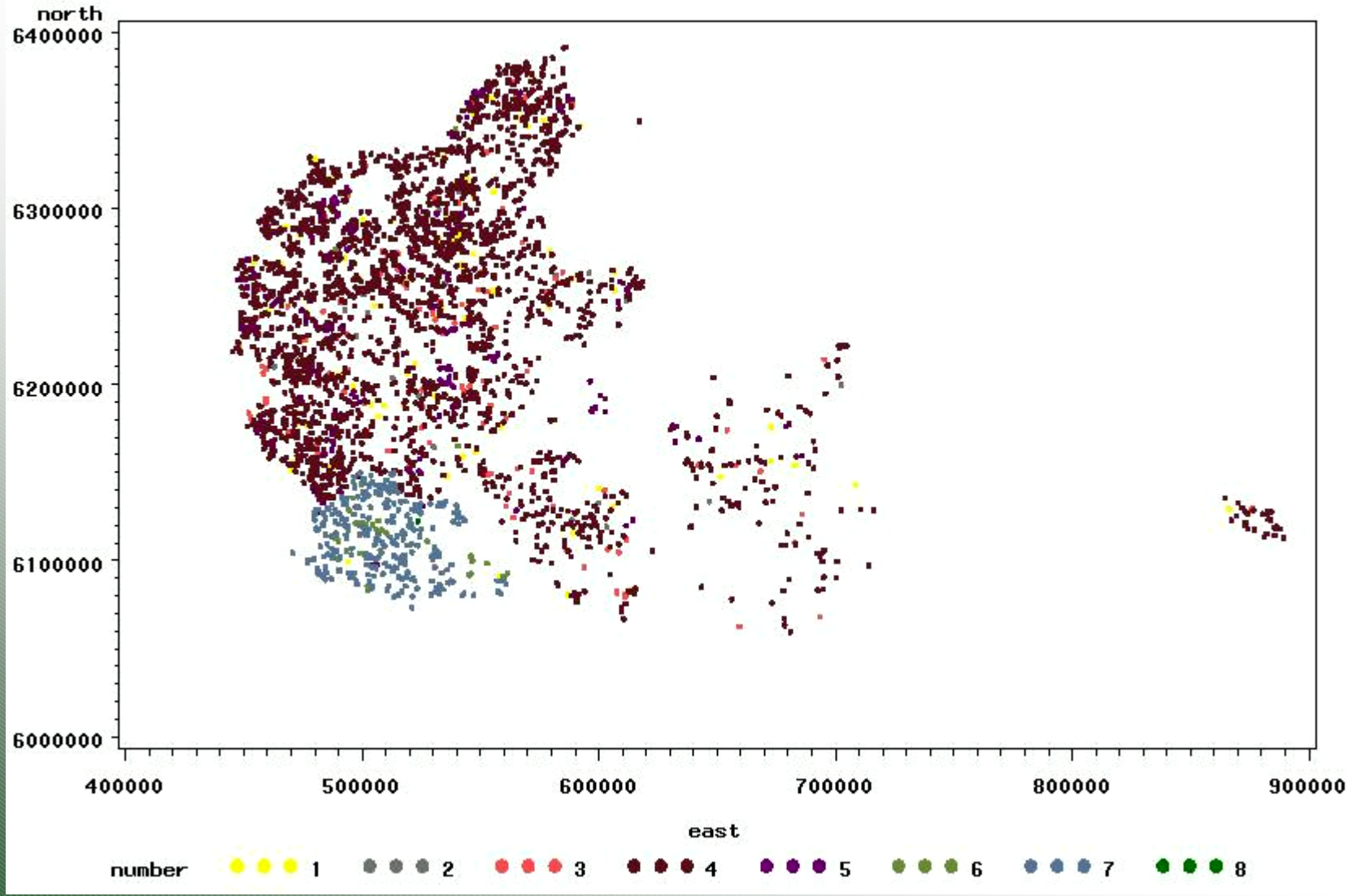
1999 milksampling



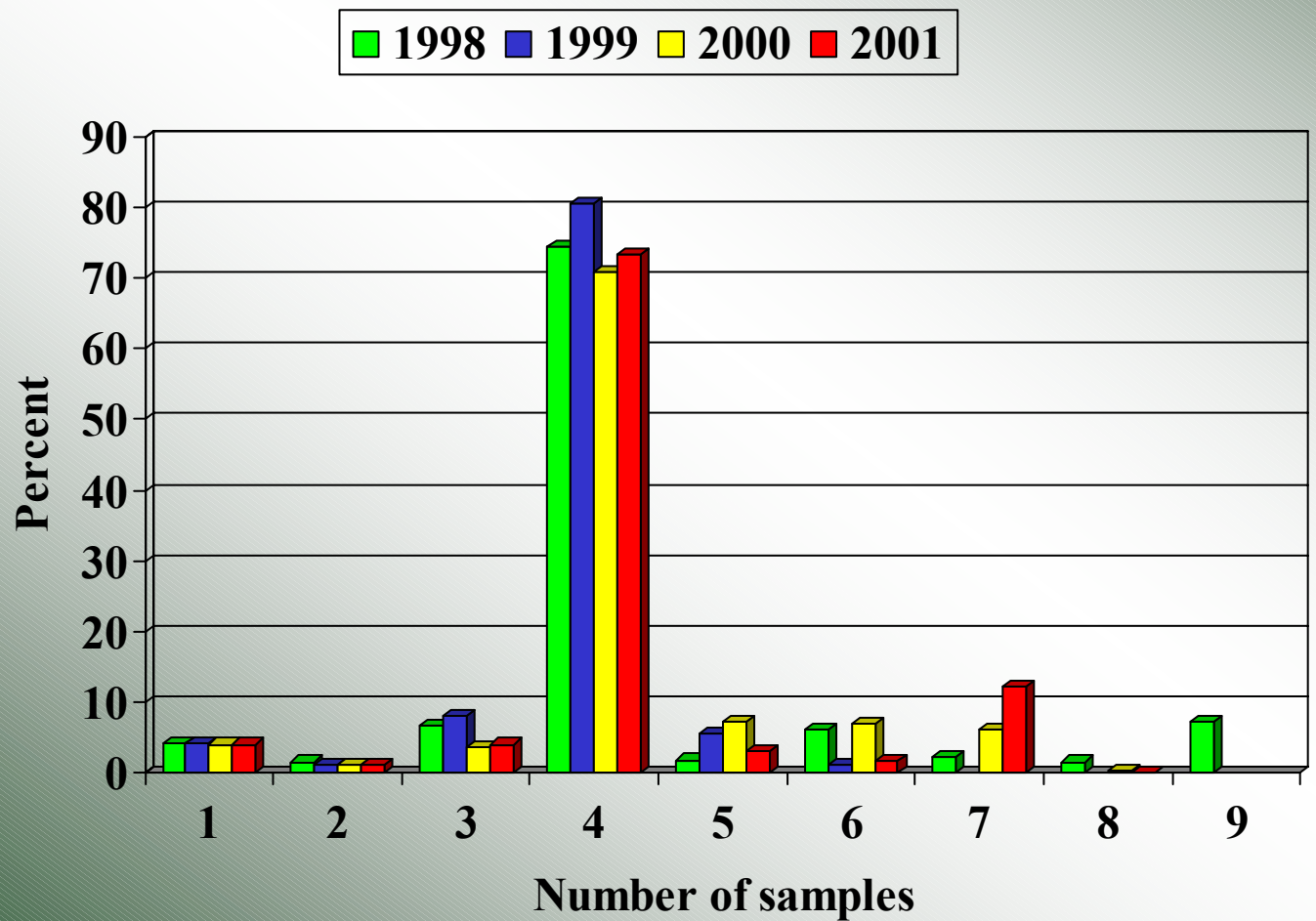
2000 milksampling



2001 milksampling



IBR-milk testing 1998-2001



Description of the approach

- **Phase I – Description and assessment of the current surveillance system using the IBR as a disease model**
- **Phase II -**
  - **Propose a sampling strategy for the national surveillance system for three exotic diseases.**
  - **Propose a sampling strategy for the herd certification program for salmonellosis and paratuberculosis.**
- **Phase III – Integration of the above approaches in a system for declaring the country free from specific diseases**

A sampling strategy for the national surveillance system

- **Enzootic Bovine Leukosis (EBL), Infectious Bovine Rhinothracheitis (IBR), and Bovine Virus Diarrhea (BVD)**
- **Disease characteristics will be considered such as clustering and rare event**
- **Simulation models will be considered to determine the impact of the sampling strategy on the detection of the disease if a case exists**
- **Cost effectiveness will be a determinant factor in the selection of a strategy**

A sampling strategy for the herd certification program

- Certification program depends on the confidence in the negative results of the testing system
- Salmonellosis and Paratuberculosis
- Targeted high risk population will be considered
- Simulation models will be considered to determine the impact of the sampling strategy on the detection of the disease if a case exists
- Cost effectiveness will be a determinant factor in the selection of a strategy

Integration above findings in a comprehensive system

- **A comprehensive system for declaring the country free from specific diseases is needed**
- **The system should be cost effective, scientifically based, and acceptable by the trade counterparties**

Conclusion

- **The broad application of this approach to other animal and public health problems such as food safety**
- **The application of this method of the region to be declared free from a specific disease**
- **The integration of veterinary services with a diagnostic laboratory system for better understanding of the disease status in a country**